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Electricity Demand Forecasting: A Survey of Methodologies and Projections

by *Rodger Weaver*, Senior Research Economist

Editor's Note:

As reported in last month's issue of the **Utah Economic and Business Review**, *nine geographic areas of Utah have been identified by the Utah Consortium for Energy Research and Education (UCERE) as "suitable power plant siting zones."*

Work of the Consortium resulted in the "Utah/Great Basin Energy Facility Siting Study" report, prepared for the U.S. Department of Energy. University of Utah, Utah State University and Brigham Young University are the Consortium members; Dr. Ronald J. Pugmire, associate vice president for research at the University of Utah, is project coordinator. Principal investigators on the project are R. Thayne Robson, University of Utah; Terrence F. Glover, Utah State University, and Richard M. Oveson, Brigham Young University. The project was funded by the U.S. Department of Energy uder Contract No. DE/ASO 3-77 SFO-1484.

One of the major questions addressed by the UCERE study committee as a basis for their plant siting zone selection was that of electrical energy demand over the next two decades. Bureau of Economic and Business Research Senior Economist Rodger Weaver was assigned the research on this important issue. Dr. Weaver's findings, analyses and conclusions are summarized in the article which follows.

Growth in demand for electricity in the Western United States during the next two decades will be in the range of from 2.7 to 4.7 percent per year. The higher growth rate (4.7 percent) represents current expectations of the utility companies presently generating electricity in the West. Basically, it indicates a continuation of the demand growth behavior during the 1970s.

The lower rate (2.7 percent per year) is produced from a synthesis of low growth-conservation oriented projections for a number of electricity service areas. It can be taken as a lower limit to a reasonable range of projections in the sense that truly drastic governmental policies combined with heretofore unheard of rates of growth in electricity prices would probably be required to produce a lower rate of consumption.

A primary finding of the Utah Energy Consortium – based on methodologies and projections which will be discussed in the remainder of this article – is that lacking some presently unspecified major changes in consumption patterns, the task of satisfying the electricity needs of the Western States until the year 2000 will require capacity expansion of approximately 3000 to 5000 megawatts (MW) per year.

In considering the demand side of the market, the objective has been to collect and evaluate the existing literature on projection methodologies in order to establish a set of criteria against which individual projection series can be evaluated. Demand projections for the Western United States have been collected from a wide variety of sources and have been evaluated in terms of the findings of the review of the modeling-methodology literature.

The purpose of this review was not to set forth a best or most likely projection, but rather to identify the major influences on future demand for electricity and to investigate current thinking as to how these influences operate in general and what they may imply for future generation capacity expansion in the West. Neither selection of a single most likely projection nor independent production of a new set of demand forecasts was intended. For the purposes of the present project, it has been sufficient to synthesize a reasonable range of values within which electricity consumption can be expected to grow over the next two decades.

I. Electricity Consumption in the Eleven Western States – History and the Future

In analysis and projection of demand for electrical energy two separate but related measures of consumption must be addressed. The first, and intuitively most obvious in terms of meaning and importance, is referred to either as *energy* or *load*. This measure deals with the total amount of electrical energy produced and consumed over a specified amount of time, and is usually expressed as some multiple of watt hours – kilowatt hours (kwh) or gigawatt hours (gwh) – per year or, less frequently, as average energy for a year. The most obvious function of the energy or load measure is as an indication of the amount of primary energy resources – coal, oil, natural gas, nuclear fuel, flowing water – required to meet a year's electricity consumption requirement.

Human activity is organized in such a way that electricity usage is not distributed uniformly through time. During some periods of the day, for example, few residential appliances are in operation. In the morning and early evening hours, however, larger numbers of such appliances are in use. Similarly, because of the preference for day shift timing of manufacturing, commercial, governmental, etc., activities, these customer classes also tend to exhibit periods of relatively light and relatively heavy usage throughout the day. Thus, temporal patterns of human activity tend to organize load into periods of heavy and light energy requirements. This phenomenon is known as load peaking and leads to the second important measure of electricity usage, *peak load* or *demand*.

Peak load, usually measured in megawatts (MW), is defined as the maximum power required during a very short period of time (formally, a single instant) within the overall projection interval (year). In addition to the daily peaking phenomenon discussed above, energy use viewed across a year exhibits peaks which are largely weather-related. Areas which experience severe winters are subject to winter peaks due to space heating requirements, while hot summer areas experience summer peaks due to air conditioning usage. Another factor in the yearly peaking is the seasonality of certain economic activities. The prime case is agriculture where irrigation pumping requirements tend to contribute to a summer peak.

The importance of a utility's peak load forecast is that this figure represents the total power the utility must be able to supply either through use of its own generators, by purchase from other utilities, or some combination of its own generation plus purchases, during the year. With current technology, it is possible but not feasible to generate energy during periods of off peak load and store it for transmission and distribution during peak periods. Thus, the system must maintain at all times the capacity to meet peak load, even if the peak period is very short and load during most of the year is substantially

below peak. One of the main reasons for the development of widespread inter-ties among utilities is to enable individual systems to purchase peaking power from other systems whose peaks occur at different times of day and of the year.

The importance of the peaking problem derives from the high cost of constructing generation facilities. The cost of construction of larger coal fired power plants ranges into the hundreds of millions of dollars, and nuclear plants are still more expensive. Utilities are, of course, reluctant to incur the large debt service expenses of such plants if they are to be used only for peaking purposes. The capital costs of smaller oil and gas fired plants are substantially less than the large base load units and are thus favored as peaking facilities. In terms of operating costs, however, the larger plants are less expensive. (Power plant construction and operation will be discussed in a subsequent article.) Thus, the decision to meet peak loads with cheaper facilities entails the trade-off of higher generation costs.

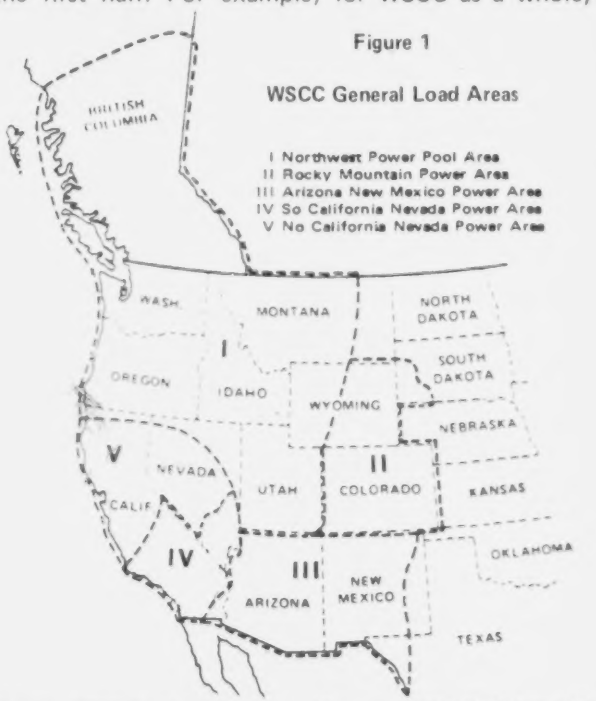
A. The Recent History of Electricity Consumption in the West

In order to understand the history of electricity usage or to plan for meeting future requirements, it is necessary that both energy (kwh or gwh) data and peak load (MW) data be presented. The Western Systems Coordinating Council (WSCC) is geographically the largest of the nine regional electric utility reliability councils established throughout the United States. All of the territory of the eleven Western States, along with a large portion of British Columbia and small sections of South Dakota and Texas, are included in the WSCC area. The WSCC area constitutes the market which could be served by power plants located in Utah's Great Basin region. The total WSCC area is partitioned into five "power areas" as indicated in Figure 1.

Over the entire interval covered in Table 1, a WSCC-wide peak load increase in excess of 25,000 MW was experienced. This represents an average of 2,500 additional MW capacity required each year, or almost one Intermountain Power Project (IPP) size plant each year. Two other major observations can be drawn from the data presented in Tables 1 and 2; and Figure 2: (1) For the years 1968-78 rapid growth has occurred in both peak and energy loads throughout the Western States and especially in the smaller Rocky Mountain and Arizona-New Mexico power areas; (2) Growth in the second half of the period has been markedly slower, though still substantial, than the first half. For example, for WSCC as a whole,

Figure 1

WSCC General Load Areas



Source: *WSCC Ten-Year Coordinated Summary: 1978-1987*, Salt Lake City, Utah, 1978.

peak and energy loads grew at annual rates of 5.4 and 7.1 percent, respectively, from 1968-1972. In the period 1973-1978, growth rates for peak and energy loads were 4.3 and 3.5 percent per year, respectively, well below comparable rates for the first half of the

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Table 1

HISTORICAL FIRM PEAK LOAD BY POWER AREA

Year	Total WSCC		Northwest		Rocky Mountain		Arizona-New Mexico		So. Calif.-Nevada		No. Calif.-Nevada	
	Thous. of MW	Annual Growth Rate (%)	Thous. of MW	Annual Growth Rate (%)	Thous. of MW	Annual Growth Rate (%)	Thous. of MW	Annual Growth Rate (%)	Thous. of MW	Annual Growth Rate (%)	Thous. of MW	Annual Growth Rate (%)
1968	47.8	–	21.2	–	2.23	–	3.52	–	12.6	–	9.1	–
1969	47.9	0.2	20.8	−1.9	2.43	9.0	4.10	16.5	13.2	4.8	9.7	7.2
1970	50.6	5.6	22.0	5.8	2.59	6.6	4.57	11.5	14.0	6.1	10.3	6.6
1971	53.6	5.9	23.9	8.6	2.90	12.0	4.94	8.1	15.8	12.9	11.4	10.7
1972	59.1	10.3	26.3	10.0	3.11	7.2	5.60	13.4	16.8	6.3	12.3	7.9
1973	59.2	0.2	26.3	0.0	3.28	5.5	6.12	9.3	17.2	2.4	12.8	4.1
1974	60.3	1.9	26.7	1.5	3.59	9.5	6.71	9.6	16.8	−2.3	13.6	6.2
1975	63.2	4.8	28.7	7.5	3.75	4.5	6.56	−2.2	17.2	2.4	14.0	2.9
1976	68.7	8.7	29.4	2.4	4.06	8.3	7.02	7.0	18.6	8.1	14.6	4.3
1977	68.0	−1.0	31.0	5.4	4.51	11.1	7.27	3.6	18.8	1.1	14.5	−0.7
1978	72.9	7.2	33.5	8.1	4.59	1.8	7.94	9.2	20.1	6.9	15.8	10.0
1968-78	+25.1	4.3	+12.3	4.7	+2.36	7.5	+4.42	8.5	+7.5	4.8	6.8	5.8

Source: Base data from Western Systems Coordinating Council (WSCC).

Table 2

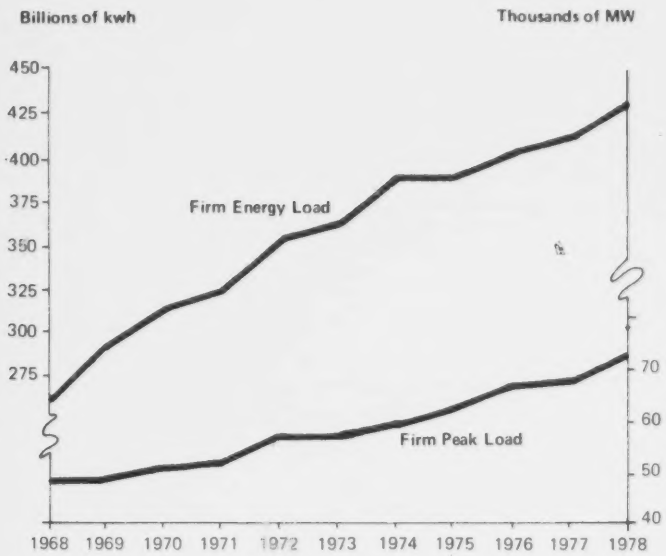
HISTORICAL FIRM ENERGY LOAD BY POWER AREA

Year	Total WSCC		Northwest		Rocky Mountain		Arizona New Mexico		So. Calif.-Nevada		No. Calif.-Nevada	
	Bil. of kwh	Annual Growth Rate (%)	Bil. of kwh	Annual Growth Rate (%)	Bil. of kwh	Annual Growth Rate (%)	Bil. of kwh	Annual Growth Rate (%)	Bil. of kwh	Annual Growth Rate (%)	Bil. of kwh	Annual Growth Rate (%)
1968	269.1	–	114.8	–	12.42	–	17.73	–	70.7	–	53.4	–
1969	289.4	7.5	124.1	8.1	13.10	5.5	20.02	12.9	75.8	7.2	55.7	4.3
1970	312.1	7.8	136.0	9.6	14.30	9.2	22.34	11.6	81.0	6.9	58.4	5.8
1971	325.9	4.4	138.3	1.7	15.79	10.4	24.35	9.0	85.7	5.8	61.9	6.0
1972	353.6	8.5	150.9	9.1	17.21	9.0	27.33	12.2	91.1	6.3	67.1	8.4
1973	365.6	3.4	152.8	1.3	19.41	12.8	30.08	10.1	94.2	3.4	69.1	3.0
1974	383.2	4.8	171.5	12.2	20.73	6.8	31.88	6.0	89.8	–4.7	69.3	0.3
1975	383.2	0.0	167.2	–2.5	21.59	4.1	30.08	–5.6	91.0	1.3	73.4	5.9
1976	408.5	6.6	178.5	6.8	23.33	8.1	33.89	12.7	95.7	5.2	77.0	4.9
1977	410.6	0.5	178.0	–0.3	24.37	4.5	35.64	5.2	96.6	0.9	76.0	–1.3
1978	434.3	5.8	189.7	6.6	25.92	6.4	37.22	4.4	102.2	5.8	79.2	4.2
1968-78	+165.2	4.9	+74.9	5.2	+13.5	7.6	+19.49	7.7	+31.5	3.8	+25.8	4.0

Source: Base data from Western Systems Coordinating Council (WSCC)

period. In considering forecasts of load and peak load for the future, the high but declining rates of growth of the past decade should constitute a working background.

Figure 2
Western Systems Coordinating Council Historical Firm Energy and Peak Loads 1968-1978



Source: Base data from Western Systems Coordinating Council (WSCC).

B. A Prospective on the Future of Demand for Electricity in the West.

The difficulties and uncertainties involved in projecting future demand for electrical energy and its load peaking characteristics are discussed later. It must suffice at this point to indicate that the number of conditions and behaviors which influence demand for electricity is quite large and the future paths to be followed by these variables can, at present, be seen only vaguely. The variables whose influence on future electricity consumption are particularly important include population growth; industrial activity expansion and alterations in industrial mix; electricity production and utilization technologies; prices of electricity and, underlying them, prices of primary energy resources, labor and capital used to produce, transmit, and distribute electricity; prices of alternative energy sources; etc. It is impossible at present to predict precisely the futures of these variables in the West and of their spatial distributions by state and substate areas. Relatively rapid population growth and economic expansion in the West appear certain. The rates of growth and expansion and their distribution are much less clear. The course of future electricity price increases is subject to both economic and political forces, neither the nature nor the influence of which can be projected with confidence. Much the same can be said for such alternative energy sources as oil and especially natural gas. The inherently unforeseen nature of major technological change insures a low likelihood of accuracy for any effort to predict the nature and impact of future major innovations.

A great deal of effort has been expended to overcome these difficulties and to design and implement projection methodologies which provide reliable guidance as to the future of the demand side of the electricity market, and of the importance of each controlling variable in influencing that future. As should be expected, a large number of projections have been produced and wide variations exist among them.

The range of growth rates projected in the various studies reviewed is from a high of 8.2 percent per year energy load growth for the State of Utah, as tabulated by the Utah Energy Office, to a declining rate of growth of −0.1 percent per year for the Pacific Northwest Utilities Conference Committee (PNUCC) area (constituting the majority of WSCC's Pacific Northwest Power Pool market). This latter figure is less an actual projection than an analysis by the National Resources Defense Council of possible consumption reductions expected from drastic public measures.

The utilities themselves are a prime source of demand analysis and projection. All private and public electricity producers in the WSCC area generate projections of their own systems' future energy and peak load demands. These are aggregated and tabulated by WSCC and are published yearly. Of all sources examined, the WSCC tabulated figures tended

to be among the highest in terms of growth rates of both measures of electricity consumption. Thus, while the utilities as a group have tended to reduce projections in each succeeding year, at least since 1973, the latest WSCC figures were selected as the upper limit of a reasonable range for both energy and peak loads.

No other geographically exhaustive series which could be compared directly to the WSCC series was discovered. It became necessary to attempt to synthesize a lower limit projection from the projections which were obtained. The procedure used consisted basically of determining the growth rate implications of a number of sub-area, conservation-oriented projections and to apply this growth rate to the same 1980 base figures presented by WSCC. The basic assumption here is that the same conservation behaviors incorporated in the selected sub-areas projections became characteristic throughout the West, and therefore the indicated lower growth rates are achieved.

No claim is made that a carefully considered projection methodology has been developed or especially, that a consistent set of controlling variable projections (population, employment, prices, etc.) underlies the results. Nevertheless, the figures presented do serve as a useful first approximation to such a carefully specified lower limit of a reasonable range of projections.

Table 3

A REASONABLE RANGE OF ENERGY AND PEAK LOAD PROJECTIONS FOR THE WSCC SERVICE AREA

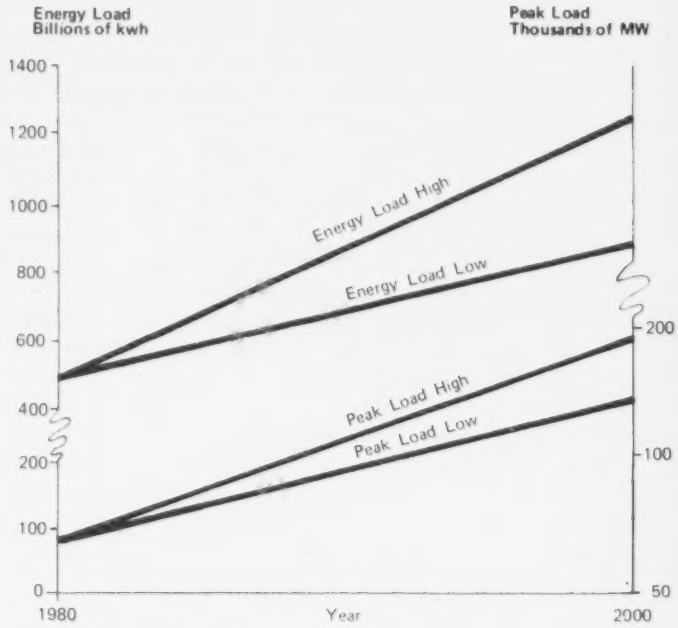
	1980		2000	
	gwh	MW	gwh	MW
High (WSCC Tabulation)	492,441	83,933	1,233,365[a]	191,201[b]
Low (See Text)			856,069	143,196

[a]This figure is produced by extrapolating the 1980-1988 WSCC projection to 2000.

[b]This figure is produced by extrapolating the 1980-1998 WSCC projection to 2000.

Table 3 and Figure 3 summarize the implications of the work reviewed in this project regarding the future of energy demand in the Western U.S.

Figure 3
A Reasonable Range of Energy and Peak Load Projections for the WSCC Service Area.



As indicated, both the high (WSCC) and low projections represent significant growth through the rest of this century. From 1980 levels of more than 492,000 gwh and almost 84,000 MW energy and peak loads, respectively, the aggregated producers' projections, as reported by WSCC, indicate expected annual growth at rates of 4.7 and 4.2 percent, respectively. These rates indicate that by the year 2000, total energy production will increase by almost 741,000 gwh per year to over 1,233,000 gwh. Peak load, as seen by the utilities, is expected to increase by more than 107,000 MW to over 191,201 MW. This represents an annual average yearly capacity increase of well over 5,000 MW, or in absolute figures, twice the average annual capacity expansion required by peak load growth during the 1968-1978 period, despite the higher rate of growth in the earlier period.

The lower limit projections are based on a 2.8 percent per year rate of growth in energy load with peak load being projected as a constant proportion (load factor) of energy load. The result is that energy demand is projected to increase by almost 364,000 gwh to just over 856,000 gwh by the year 2000. The peak load implication is for a growth rate of 2.7 percent per year, or an average annual increase of almost 3,000 MW. Thus, even with the marked reduction in *rate* of growth in the lower limit projections, the implication for capacity requirements is that a more rapid accumulation of *capacity* will be needed over the next two decades than was experienced in the 1968-1978 interval.

A great deal of care must be exercised in interpreting these projections. It must be borne in mind that they do represent, basically, a continuation of past behavior patterns; especially pricing practices and the magnitudes of price increases. It is entirely conceivable that primary energy resource scarcity may be translated into electricity price increases of such magnitude that even the demand growth path indicated by the lower limit projection will not be realized. Other policies designed to foster conservation may strengthen such a tendency. Also, policies designed to "smooth out" consumption over time may reduce peak use sufficiently that needed capacity may grow at a significantly lower rate than total energy consumption. In this event, the capacity expansion requirements of the energy load growth projections – upper or lower limit – will be overstated. (The magnitude of this overstatement is limited, however, in that it remains necessary to maintain excess capacity both for scheduled maintenance outages of generating units and to cover accidental forced outages of generation and transmission facilities.)

The width of the range of projected demand for electrical energy presented here emphasizes the high degree of uncertainty involved in preparing such projections. Nevertheless, even the low growth scenario represents major augmentation of current capacity over the next 20 years. A brief summary of the technical-analytical-methodological issues underlying the production of electrical demand projections follows.

II. Electricity Demand Projection – Issues of Method and Analysis

This section deals with some of the technical, methodological and analytical problems of electricity demand projections. An introduction to the principles involved in the development of forecasting methodologies will be presented in Subsection A. This will be followed in Subsection B by a general discussion of the ways in which the problem has been addressed and of the issues involved in evaluating alternative approaches. Subsection C summarizes the mainstream literature on formal projection methodologies and models and sets out the major points of consensus and conflict in this literature. Finally, Subsection D describes what appear to be the major areas for important advances in the state of the art in the near future.

A. Who Makes Projections?

Not surprisingly, the history of electricity demand forecasting begins with the producing utilities themselves. The interest here is the crucial bread-and-butter concern with correctly anticipating sales in order to be able to provide a production-transmission-distribution system which is adequate to meet customers' purchase requirements without creating costly excess capacity. As the cost of capacity expansion increased and lead times required to bring new generating units on line lengthened, the utilities recognized the need to coordinate their efforts, improve the reliability of methodologies used, and to widen the range of questions which could be addressed. As a result, demand forecasting functions, especially regarding development of new approaches and refinement of existing techniques, have been assigned to such voluntary industry organizations as the Edison Electric Institute (EEI) and the Edison Power Research Institute (EPRI). Also, a collection-coordination-dissemination role has been assumed by the National Electric Reliability Council and the nine regional councils. The interest of the utilities in advancing the state of the art, especially at the level of EPRI and EEI, is strong. However, the requirement that the methods adopted by the utilities support resource commitment planning insures a healthy

skepticism regarding new, and as yet untried and unproven, approaches. The utilities are, quite appropriately, somewhat conservative in placing exclusive confidence in new projection techniques from whatever source and, therefore, maintain a significant role for the judgment and local expertise aspects of what is described in Subsection B as the traditional approach.

Academic interest in analyzing and, especially, projecting electricity demand is of relatively recent vintage, with the first studies dating from the early 1960's. The interest of academicians in the phenomenon of electricity demand is only partially practical, and much of their work has not been directly useful to utilities. Significant advances have been made by the academic community, however, in understanding the conditions and influences which operate to determine the level and timing of demand for electricity. As these findings are incorporated into the public sector in the development of new policies toward both the consumers and producers of electricity, their practical influence on both energy and peak loads should become highly significant.

Federal and state governmental agencies are also, to varying degrees, actively involved in demand forecasting. The posture of the projection teams in these agencies depends on the agencies' particular missions. These vary from simply providing an independent forecast which can be responded to in general policy formulation to a particular mandate for investigating ways to curtail growth in consumption. The questions asked and the methods used to answer them are both strongly influenced by these considerations and, therefore, the nature of the projection techniques adopted and the projections generated must be interpreted, in part, from the point of view of agency mandate.

As a final note, it must be emphasized that there exists a high degree of interrelationship among the groups involved in demand projections. Both utilities and government agencies utilize academic expertise. The role of utilities' academic research efforts is as often that of active participant-contributor as that of passive object-of-examination/provider of data. Finally, a substantial amount of what may be thought of as high quality academic research is carried out by research agencies in the utility companies themselves and in state and federal agencies.

B. How Are Electricity Demand Projections Produced?

Methods of demand forecasting are as varied as the purposes to which the forecasts can be put and the different levels and types of training of the people or groups producing them. The traditional approach of the utilities is to combine relatively simple but well tested econometric techniques with extrapolation of recent growth experience and, of special importance, to temper these calculational techniques with the judgments of company personnel as to the prospects for increase in the numbers of customers and in the consumption levels of existing customers in small subareas of the company's total market. At the other extreme, the econometric approach has been applied to produce large-scale, extremely complex and elaborate sets of equations attempting to incorporate in explicitly quantifiable and mechanical fashion, as many as possible of the factors thought to influence consumption, with little if any role for individual judgment in the actual production of projections. (Judgment is, of course, crucial in specifying the set of equations and in estimating the values of the parameters involved.) Between these extremes and among representatives of each, a very wide variety of individual methodologies has been developed.

All of these techniques, however, incorporate three basic components. They all are based upon a *model* of behavior which produces a projection based upon *data* and *assumptions*. Here, the term "model" is used to indicate the set of relationships which are thought to explain or control how the future course of electrical demand may develop. These relationships may be stated explicitly as a formal system of mathematical equations or they may remain implicit or notional in the form of a set of beliefs and expectations in the mind of an individual forecaster. For example, the judgment of a utility's local service representative is produced by such an informal, notional model. The models considered here are

usually set out formally, but they always reflect the notional model of their creators.

Any model, formal or notional, requires information about the relative quantitative magnitudes of its interrelated components in order to generate specific projections. In this report, the term "data" will be used to denote information regarding completed historical behavior. The term "assumption" will usually be used to indicate expectations about future developments regarding phenomena which, according to the model, control load or peak load growth.

A simple example may indicate these distinctions. A model may be of the form:

LOAD = (LOAD PER CAPITA) X (POPULATION).

This is a model because it expresses a relationship between overall behavior of the system, as measured by POPULATION (an independent variable), and LOAD (the dependent variable). Of course, more elaborate models would include more independent variables than just population and more complicated mathematical relationships. In this example, data would consist of a number of pairs of realized populations and loads. These would be used to calculate the historical LOAD PER CAPITA figure and, perhaps, trend indicated future values. Future values of the independent variable (POPULATION) enter the model as assumptions and the model can be used to project the impact of alternative assumptions reflecting different population growth (or decline) scenarios. The projection year values of LOAD PER CAPITA are also assumptions, whether they reflect a constancy assumption, projected trend change, or values produced through some other analytical or intuitive procedure. The result of the model operating on the data and based on assumptions is the forecast or projection into the future of load growth or decline. All models discussed in this report, however elaborate and challenging, and whether formal or informal, are of this type.

In reviewing alternative forecasting methodologies an ends/means framework has been adopted. Work of this sort, like all other, requires the expenditure of human and material resources and time. Increases in resources devoted to the modeling-forecasting effort can reasonably be expected to increase forecast reliability and, especially, to increase understanding of the causes of change in electricity uses. In many cases, however, less expensive procedures may produce results which are adequate for the purpose at hand. In such cases, adoption of more costly alternatives would produce a degree of refinement, the value of which would be exceeded by its cost. Thus, use of the "better" methodology would not be justified by the contribution to improved planning and decision making expected from it. In the literature, the word "sophisticated" is used to indicate that high degrees of detailed formal analytical and statistical techniques are used in a given methodology. This word seems also to bear the connotation "better." To avoid the implication that sophisticated techniques are to be preferred in all cases, the word "elaborate" has been adopted to indicate the detail and formality of the techniques used.

The following issues have been used to guide consideration of the various projection methodologies:

(1) *Projected future levels of activity in the service area and the role of such projections in the model.* Demand for energy of all sorts in any area depends upon the number of people living in the area, their groupings into individual households, and their selections of housing types; and upon the amount of economic activity in the area and its distribution across industrial sectors.

(2) *Price and income effects on demand for electricity.* Assuming given levels and compositions of population and economic activity, it is reasonable to expect that demand for energy in any utility's service area will increase with increases in area income and with decreases in energy prices relative to prices of other commodities. Further, demand for electricity can be expected to vary directly with prices charged for alternative energy sources. Thus, the treatments accorded income, price of electricity, and prices of

other types of energy in projecting demand for electric power in any projection methodology must be evaluated.

(3) *Effects of regulatory and other governmental actions on level, and especially geographic distribution, of demand.* Effects on level of demand for energy of all sorts could result from possible federal policies to promote energy conservation. Such policies could also affect the demand for electricity specifically as a result, for example, of efforts to shift from electricity to alternate energy sources for space heating purposes. Other influences on demand for new coal-fired power plants could be expected from governmental efforts to induce shifts away from oil and gas as a steam fuel.

(4) *Electricity utilization technology.* Future improvements in the efficiency of the technology through which electrical energy is put to use can be expected. For any overall level of activity, these improvements will result in lower demand for electricity. Thus, the treatment of consumption technology is an important component in evaluating any projection methodology.

C. Formal Model Formulations

Attention at this subsection is limited to formal models, i.e., to those consisting of an explicit set of equations calibrated with a specific set of data and producing projections conditioned by a particular set of assumptions. The diversity of the models reviewed prohibits even a cursory discussion of each. Rather, a general discussion of the literature in terms of the four issues listed above will be attempted.

All of the projection models examined incorporate some measure of projection area activity as an independent variable. Further, they all disaggregate these variables into types of activity, usually along traditional customer class lines: residential, commercial, and industrial classes. The more elaborate models provide further disaggregation by adding additional categories such as street lighting, agriculture, etc., and/or by breaking the major classes down by type of housing unit, urban vs. rural location, etc.

A great deal of research has been done in an attempt to quantify the relationship between electricity prices and quantities of electrical energy consumed. The findings of this research have been incorporated into nearly all the more elaborate models. A major exception is the residential sector demand model of the California Energy Resources Conservation and Development Commission. Many of the simpler formal models, such as that of the Nevada Department of Energy, do not include an explicit price variable, but do make assumptions about future per capita consumption.

The effects of both income and prices of alternative energy sources (usually natural gas) on electricity consumption have also been extensively investigated. Again, typically, the implication of this research has been incorporated into the more elaborate models.

Analysis of the influence of government regulation on consumption has followed two paths. The first is related to the price variable. Electricity prices are set by public agencies, and thus reflect public policy. The price variable itself is, therefore, partially a public policy variable. A more interesting relationship between public policy and price is the price structure itself. At the present time, study is underway on the potential impact of a shift from the traditional declining block rate pricing mechanism to alternative rate structures such as flat rates, "lifeline" structures, time-of-day systems, etc., on consumption and especially on peak load. Results of these investigations have not as yet been included in formal demand projection models.

The second relationship between public policy and electricity consumption has been the effort to include the impacts of compulsory energy conservation policies. Some models have attempted such an incorporation, but much work remains to be done before the efforts can be thought of as satisfactory.

The technology of electricity utilization as it affects consumption has also been the subject of extensive research and analysis. In the class of models called end use models, the stock of electricity-using appliances is projected explicitly, usually with some

degree of disaggregation by appliance type. Use coefficients are applied to these appliance stock projections in order to generate total consumption figures. The crucial role of utilization technology changes is built into the analysis and projection of these coefficients. This has been a particularly useful avenue for analysis of the impacts of proposed major appliance redesign proposals in response to either market signals or governmentally imposed efficiency standards.

The class of models which does not explicitly project the stock of appliances is called commodity models. In this class, explicit treatment of consumption efficiency increases is difficult. Nevertheless, indirect incorporation of these effects is frequently made in development of assumptions about future consumption per customer, however that phenomenon may be formulated in a specific model.

From the modeling literature review, a set of core independent or controlling variables common to most of the models considered has been identified, as expected. These consist of (1) a more or less complex set of projections of economic and population activity in the projection area, (2) an electricity price variable, (3) a variable reflecting the price of alternative energy sources, and (4) some measure of area income. In addition to this set of core variables, different analysts have found significant relationships between electricity consumption and each of the following variables:

- climate
- mineral production
- average household size
- percent of population in rural subareas
- residence size
- population density
- percent of dwelling units which are single family units
- number of housing units per capita
- labor cost indices

Table 4 summarizes current thinking about the strength and nature of the relationships among the core variables.

In Table 4, the term elasticity is used in its formal economic sense to indicate the strength of a given relationship. Elasticity is defined as the percent change in the dependent variable (electricity consumption) divided by the percentage change in the independent variable (price of electricity, price of other energy sources, income). For convenience, elasticity values are broken into ranges of (1) relative elasticity (elasticity greater than one in absolute value), where a given percentage change in the independent variable produces a greater percentage change in the dependent variable; and (2) relative

Table 4

RELATIONSHIPS BETWEEN CORE VARIABLES AND ELECTRICITY CONSUMPTION

Core Variable	Short Run	Long Run
Price of Electricity	Relatively inelastic, frequently less than .25 in absolute value. Industrial use more elastic than residential.	Relatively elastic ranging up to 2.0 in absolute value.
Price of Other Energy Sources	Quite inelastic. Industrial use more elastic than residential.	Relatively inelastic, but greater than in short run. Typical values approach .5 in absolute value.
Income	Relative inelastic but significant.	Relatively elastic in most studies, but some range as low as .29.

inelasticity (elasticity less than one in absolute value), where the percentage change in the dependent variable is less than the associated percent change in the independent variable. Thus, a relatively elastic relationship indicates a more rapid response than does a relatively inelastic one. Relative inelasticity does imply a significant relationship, however, with that significant declining as elasticity approaches zero.

The importance of the findings summarized in Table 4 is that despite the fact that rising population, economic activity, and incomes exert strong upward pressures on any area's consumption of electricity, the effects of price increases reflecting increasing relative scarcity of energy resources can be expected to mitigate these increases as a result of individual consumers' responses to market stimuli. These effects along with the effects of public energy conservation policies are the bases for the low growth scenarios used to synthesize the lower limit projections presented in Section I.

D. Conclusions and Prospects for Future Developments

From this review of electricity demand projections and projection methodologies it seems clear that the mainstream literature has established reasonably well the basic behavioral relationships which have controlled electricity consumption in the past, and has provided reasonable projections of future energy and peak load demands if the future electricity production-consumption system remains basically the same as it is today.

Interesting advances are presently being made which will provide technology to simulate with projection models the impact on consumption of major changes in the structure of electricity markets. Primary among these is the investigation of the impacts on both energy loads and peak loads of innovative pricing structures. At the present time, virtually all electrical energy in the U.S. is delivered under the declining block rate price structure in which users of larger amounts of power are charged a lower rate per kwh than users of smaller amounts. A variety of alternative schemes is being considered. These include inverted or increasing block rates, flat rates, and lifeline rates, each of which could affect energy load, possibly very significantly.

The most interesting alternative pricing proposals fall into the general class of marginal cost pricing schemes. Such structures attempt to set individual customers' bills equal to the costs incurred in producing the power they actually use. Under such a structure, consumption of a given amount of electricity during periods of peak demand, which normally require generation of electricity with the most costly marginal generating units, would be more expensive than consumption of the same amount of electricity at other than peak periods. Peak-load or time-of-day rate structures are variants of marginal cost schemes. To the extent that users have different degrees of responsiveness to the price of electricity, those users whose demand for electricity exhibits more responsiveness may change their temporal pattern of consumption in order to minimize their total outlays. Such changes will reduce daily or seasonal peak demand, with the end result that the system as a whole would not need as much total generating capacity, even if it continues to produce and consume the same total electrical energy.

The effects on electricity consumption of public policies designed to promote electricity conservation are also being investigated. Such policies fall into three categories:

(1) *Financial incentives* which are voluntary in the sense that they call for individual consumers to reduce consumption in response to either higher prices or higher net appliance purchase costs, or in response to tax incentives designed to foster improved insulation, implementation of alternative energy forms (such as solar heating systems), etc.

(2) *Other voluntary measures* such as public education and motivation programs.

(3) *Mandatory conservation measures* such as increasing insulation requirements in building codes, requiring lower thermostat settings, or limiting times for commercial display lighting.

The potential of such public policies are, as yet, only imprecisely understood. However, as this understanding is improved, it can be incorporated into demand projection models to simulate the policies' potential impacts on electricity consumption.

Utah Business Statistics

Statewide Statistical Data

	Nov. 1979	Oct. 1979	Nov. 1978	% Chg. From Year Ago	12 Mo. Average Ending Nov. 1979	Nov. 1978	% Chg.
Agriculture							
Cash Receipts from Farm Marketings (thous. of dol.)*	na	51,615	48,019	na	na	33,900	na
Livestock and Livestock Products (thous. of dol.)	na	39,482	33,572	na	na	25,800	na
Crops (thous. of dol.)	na	12,133	14,447	na	na	8,149	na
Avg. Prices Rec'd by Farmers (15th of each mo.)(dol.):							
Beef Steers and Heifers (cwt)(thou.)	69.2	68.0	55.5	24.3	69.0	49.7	38.8
Lambs (cwt)	63.7	65.5	59.6	6.9	62.8	58.8	6.8
Turkeys (per lb.)	.510	.460	.520	−1.9	0.5	.450	11.1
Milk, Wholesale (cwt)	12.5	12.2	11.1	12.6	11.6	10.1	14.9
Alfalfa Hay, Baled (per ton)	57.0	53.5	46.5	22.6	52.0	50.1	3.8
Livestock Slaughtered (live weight):							
Cattle (thous. of lbs.)	16,195	18,037	19,297	−16.1	15,914.5	19,666	−19.1
Calves (thous. of lbs.)	7	8	24	242.8	na	20	na
Sheep and Lambs (thous. of lbs.)	233	309	230	1.3	217.7	223	−2.4
Hogs and Pigs (thous. of lbs.)	2,856	2,987	2,203	29.6	2,361.9	1,886	25.2
Finance							
Loans, Total, Utah Member Banks (mil. of dol.)[a]	3,183	3,157	2,908	9.5	3,040.5	2,780	9.4
Investments, Total, Utah Member Banks (mil. of dol.)[a]	831	829	816	1.8	831.3	769	8.1
Deposits, Total, Utah Member Banks (mil. of dol.)[a]	3,916	3,909	3,670	6.7	3,796.3	3,493	8.7
Demand Deposits of Banks, Total, Utah (mil. of dol.)[a]	62	55	52	19.2	55.6	53.5	3.9
Other Demand Deposits, Total, Utah (mil. of dol.)[a]	1,258	1,289	1,165	8.0	1,169.4	1,132	3.3
Time Deposits, Total, Utah (mil. of dol.)[a]	2,597	2,565	2,453	5.9	2,572.4	2,310	11.4
Savings, Savings and Loan Association (mil. of dol.)[b]	1,672.2	1,670.6	1,475.6	13.3	1,600.0	1,473.2	8.6
Sale of U.S. Savings Bonds–Series E & H (thous. of dol.)	2,148.0	5,177.0	2,413.6	−11.0	2,485.7	2,397.3	3.7
New Corporations (no.)	371	442	384	−3.4	408.2	396	3.1
Tax Collections by the State of Utah (thous. of dol.)							
Total Tax Collections	127,745.6	41,625.8	120,603.2	5.9	70,770.8	61,937.2	14.3
Sales & Use Tax	82,055.4	15,107.6	82,657.3	−0.7	30,344.7	38,951.2	−22.1
Motor Fuel Tax	6,075.8	8,086.2	3,262.9	86.2	5,616.8	4,475.6	25.5
Individual Income Tax	35,033.3	10,970.2	30,239.7	15.9	23,991.6	19,848.7	20.9
Corporation Franchise Tax	621.5	3,571.7	1,049.2	−40.8	3,064.2	2,848.2	7.6
Employment							
Civilian Labor Force (thous.)[c]	632.7	632.3	601.5	5.2	615.8	583.4	5.6
Total Employed Persons	606.3	609.6	575.0	5.4	590.5	556.5	6.1
Unemployed	26.4	23.0	26.5	−0.4	28.4	26.7	6.4
Percent Total Labor Force	4.2	3.6	4.4	−4.5	4.6	4.6	0.0
Employees on Nonagricultural Payrolls (thous. of jobs)	576.2	574.6	544.6	5.8	554.1	521.3	6.3
Manufacturing	88.8	87.8	84.9	4.6	84.8	79.3	6.9
Mining	18.2	18.0	17.1	6.4	17.5	15.7	11.5
Contract Construction	37.6	39.4	35.5	5.9	37.0	34.7	6.6
Transportation, Communication and Utilities	35.1	35.0	32.8	7.0	34.0	31.4	8.3
Wholesale Trade	35.4	35.5	31.8	11.3	34.5	31.1	10.9
Retail Trade	104.1	101.5	99.9	4.2	99.8	87.6	13.9
Finance, Insurance and Real Estate	26.3	26.3	25.0	5.2	25.7	24.3	5.8
Services[d]	103.3	104.3	93.4	10.6	99.0	90.3	9.6
Federal Government	35.6	36.1	35.9	−0.8	37.0	37.0	0.0
State Government[e]	34.4	33.7	34.3	.3	32.0	31.6	1.3
Local Government[e]	57.3	56.9	53.9	6.3	54.8	51.1	7.2
Average Weekly Hours:							
Manufacturing	39.8	38.4	40.7	−2.2	39.0	39.6	−1.5
Mining	41.3	40.9	42.2	−2.1	41.7	42.7	−2.3
Contract Construction	38.7	38.6	36.6	5.7	37.5	39.6	−5.3
Wholesale Trade	37.5	37.1	36.6	2.5	37.5	36.7	2.2
Retail Trade	27.6	28.2	27.7	−0.4	28.1	28.7	−2.1
Amount of Unemployment Comp. (thous. of dol.)	2,800.6	2,702.5	2,919.6	−4.1	3,873.4	3,197.7	21.1
Construction							
Total Construction (thous. of dol.)	109,962	146,874	79,107	39.0	122,546.7	106,595	15.0
Residential	45,789	56,727	52,496	−12.8	60,669.2	59,138	2.6
Nonresidential	33,676	86,016	22,737	48.1	46,854.3	37,262	25.7
Public Works and Utilities	30,457	4,131	3,874	686.2	15,021.0	10,319	45.6
Total Permit Construction (thous. of dol.)[f]	90,968.8	137,295.1	98,301.8	−7.5	103,392.0	96,833.9	6.8
Residential	31,981.6	49,379.9	51,951.0	−38.4	54,605.5	62,995.3	−13.3
Nonresidential	46,693.1	77,087.6	39,737.0	17.5	41,215	28,960.7	42.3
Additions, Alterations and Repairs	9,294.1	10,836.6	6,612.9	40.5	7,066.6	5,954.8	18.7
New Dwelling Units (no.)	773	1,336	1,473	−47.5	1,435.1	1,847	−22.3
Tourism/Travel							
Air Passengers (total no. on and off)	348,670	355,455	315,268	10.6	384,650	348,491	10.4
Highway Traffic Count Across State Lines	33,845	38,847	33,156	2.1	38,265	41,586	−8.0
Transient Room Taxes (thous. of dol.)	486.2	151.2	563.1	−13.7	183.0	156.5	16.9
Visits, State, Nat'l. Parks, Monuments (thous.)	283.7	732.7	334.1	−15.1	1,014.5	1,151.7	−11.9
General							
New Cars and Truck Sales							
C.P.I. (National Index – 1967=100)	227.5	225.4	202.0	12.6	214.9	194.0	10.8
Telephones in Service. (Business)	75,413	75,163	71,272	5.8	73,453	69,721	5.4
Telephones in Service. (Residential)	406,057	404,326	389,187	4.3	394,917	375,776	5.1
Electric Customers (Commercial)	32,282	32,105	30,991	4.2	31,667	30,008	5.5
Electric Customers (Residential)	344,669	343,638	331,887	3.9	339,554	323,650	4.9
Natural Gas Customers (Residential & Commercial)	364,335	357,285	348,601	4.5	358,852	340,675	5.3
Natural Gas Customers (Industrial)	635	635	670	−5.9	656	670	−2.1
Production							
Net Electric Power Utilized (mil. of kwh)	1,010.0	957.7	1,006	0.4	904.2	909.8	−0.6
Crude Oil to Refineries (thous. of bbls.)	4,994.1	4,864.1	5,496.4	−9.1	4,915.8	5,190.1	−5.3
	(Oct. 79)	(Sept. 79)	(Oct. 78)		(Oct. 79)	(Oct. 78)	
Crude Oil Production (thous. of bbls.)[i]	2,159.2	2,280.3	3,058	−29.4	2,579.8	2,841.2	−9.2
Natural Gas Production (mil. of cu. ft.)	7,002.8	6,817.6	7,210	−2.9	6,191.9	6,581.7	−5.9
Coal (thous. short tons)	954	1,101	942	1.3	996.4	867	14.9
Copper (thous. metric tons)[g]	15,169	16,814	17,156	−11.6	15,446.4	15,714	−1.7

Utah Business Statistics

MULTI-COUNTY PLANNING DISTRICT STATISTICAL DATA	Nov. 1979	Oct. 1979	Nov. 1978	% Chg. From Year Ago	12 Mo. Average Ending Nov. 1979	Nov. 1978	% Chg.
Wasatch Front (Salt Lake, Tooele, Davis, Weber, Morgan Counties)							
Non-Ag. Employment (thous.)*	409.5	406.2	387.2	5.8	395.3	371.5	6.4
Auth. Permit Construction (mil. of dol.)	67.3	83.8	64.5	4.3	66.5	62.2	6.9
New Dwelling Units	444	812	954	−53.5	892	1,183	−24.6
Postal Receipts (thous.)†	8,306	4,494	4,050.1	105.1	4,802.7	4,022.3	19.4
Electric Customers (Residential)	263,970	261,364	254,853	3.6	260,675	249,036	4.7
Electric Customers (Commercial)	21,066	20,934	19,577	7.6	20,699	19,447	6.4
Natural Gas Customers (Residential)	270,420	265,524	258,591	4.6	266,741	252,824	5.5
Natural Gas Customers (Industrial)	468	466	494	−5.3	467	484	−3.6
Department Store Sales (mil. of dol.)	34,137	25,916	31,317	9.0	26,202	25,169	4.1
Salt Lake City							
Non-Ag. Employment (Salt Lake and Tooele)(thous.)*	312.6	97.1	294.7	6.1	292.1	275.4	6.1
Auth. Permit Construction (mil. of dol.)*	30.2	34.6	5.6	439.3	15.6	7.7	102.6
New Dwelling Units	20	13	26	−23.1	48.5	73	−33.6
Postal Receipts (thous.)†	6,711	3,723	3,340.5	100.9	3,909.5	3,056.4	27.9
Natural Gas Customers (Residential)	56,755	55,572	56,602	0.3	56,784	55,978	1.4
Natural Gas Customers (Industrial)	168	168	186	−9.7	174	181	−4.1
Telephones in Service. (Business)h	41,719	41,619	39,505	5.6	40,751	38,821	5.0
Telephones in Service. (Residential)h	207,590	206,677	198,544	4.6	202,840	193,131	5.0
Ogden							
Non-Ag. Employment (Weber, Morgan, Davis)(thou.)*	96.9	309.1	92.5	4.8	95.0	91.6	3.7
Auth. Permit Construction (mil. of dol.)*	2.7	5.9	1.8	50.0	6.9	3.0	130.0
New Dwelling Units	40	118	32	25.0	49	36	35.3
Postal Receipts†	671.5	334.2	311.1	115.8	379.5	283.1	34.1
Natural Gas Customers (Residential)	21,273	20,892	21,032	1.1	21,232	21,043	0.9
Natural Gas Customers (Industrial)	63	63	64	−1.6	62	68	−9.0
Telephones in Service. (Business)i	6,980	6,950	6,628	5.3	6,790	6,458	5.1
Telephones in Service. (Residential)i	42,334	42,238	41,292	2.5	41,666	40,322	3.3
Mountainlands (Utah, Wasatch, Summit Counties)							
Non-Ag. Employment (thous.)*	73.8	73.2	69.2	6.6	70.4	65.7	7.2
Auth. Permit Construction (mil. of dol.)	8.5	19.3	21.4	−60.3	18.2	17.7	2.8
New Dwelling Units	112	278	292	−61.6	282	359	−21.4
Postal Receipts (thous.)†	1,135	571	492.2	130.6	641.0	484.1	32.4
Electric Customers (Residential)	32,153	31,935	30,465	5.5	31,269	29,461	6.1
Electric Customers (Commercial)	2,997	2,964	2,798	7.1	2,907	2,709	7.3
Natural Gas Customers (Residential)	56,780	55,489	53,963	5.2	55,772	52,044	7.2
Natural Gas Customers (Industrial)	94	96	99	−5.1	95	98	−3.5
Provo							
Non-Ag. Employment (thous.) (Utah Co.)*	68.5	67.8	64.2	6.7	64.7	60.5	6.9
Auth. Permit Construction (mil. of dol.)*	2.1	4.6	7.4	−71.6	4.4	3.6	22.2
New Dwelling Units	27	101	87	−69.0	69	73	−5.5
Postal Receipts (thous.)†	652.5	319.1	283.2	130.4	354.5	255.9	38.5
Natural Gas Customers (Residential)	14,873	14,568	14,206	4.7	14,682	14,032	4.6
Natural Gas Customers (Industrial)	44	43	48	−8.3	45.7	47	−2.8
Telephones in Service. (Business)i	6,266	6,253	5,975	4.9	6,094	5,953	2.4
Telephones in Service. (Residential)i	39,268	39,149	37,690	4.2	36,807	34,892	5.5
Central Utah (Juab, Millard, Sanpete, Sevier, Piute, Wayne Counties)							
Non-Ag. Employment (thous.)*	13.2	13.4	12.6	4.8	13.1	12.1	8 3
Auth. Permit Construction (mil. of dol.)	2.1	1.6	1.6	31.3	2.2	2.2	0.0
New Dwelling Units	28	23	30	−6.7	41	43	−5.1
Postal Receipts (thous.)†	112.5	64.9	63.7	76.6	75.0	63.5	18.1
Electric Customers (Residential)	8,825	8,799	8,504	3.8	8,677	8,310	4.4
Electric Customers (Commercial)	1,925	1,895	1,915	0.5	1,904	1,886	0.9
Uintah Basin (Duchesne, Daggett, Uintah Counties)							
Non-Ag. Employment (thous.)*	11.2	11.5	10.6	5.7	11.4	10.4	9.6
Auth. Permit Construction (mil. of dol.)	.91	1.0	1.3	−30.0	3.1	2.2	40.9
New Dwelling Units	14	17	26	−46.2	30	32	−6.3
Postal Receipts (thous.)†	94.1	45.3	41.8	125.1	52.5	42.1	24.7
Electric Customers (Residential)	4,796	4,789	4,504	6.5	4,682	4,370	7.1
Electric Customers (Commercial)	761	753	737	3.3	749	724	3.5
Natural Gas Customers (Residential)	4,729	4,624	4,591	3.0	4,678	4,580	2.1
Natural Gas Customers (Industrial)	7	7	9	−22.2	8	9	−13.3
Bear River (Box Elder, Cache, Rich Counties)							
Non-Ag. Employment (thous.)*	32.1	32.0	30.7	4.6	30.5	29.1	4.8
Auth. Permit Construction (mil. of dol.)	6.5	3.4	3.5	85.7	4.0	5.4	−25.9
New Dwelling Units	95	81	51	86.3	69	83	−17.2
Postal Receipts (thous.)†	379.6	194.5	186.1	104.0	221.0	182.5	21.1
Electric Customers (Residential)	13,926	13,900	13,432	3.7	13,700.2	13,178	4.0
Electric Customers (Commercial)	1,715	1,709	1,671	2.6	1,691	1,638	3.2
Natural Gas Customers (Residential)	23,585	23,082	22,879	3.1	23,304	22,520	3.5
Natural Gas Customers (Industrial)	51	51	48	6.3	48	48	0.6
Southeastern (Carbon, Emery, Grand, San Juan Counties)							
Non-Ag. Employment (thous.)*	20.2	20.6	19.1	5.8	19.6	17.7	10.7
Auth. Permit Construction (mil. of dol.)	1.7	5.2	2.3	−26.1	2.6	2.6	0.0
New Dwelling Units	30	61	36	−16.7	32.5	44	−26.1
Postal Receipts (thous.)†	na	na	60.8	na	na	na	na
Electric Customers (Residential)	10,677	10,585	10,234	4.3	10,476	9,915	5.7
Electric Customers (Commercial)	1,402	1,400	1,369	2.4	1,389	1,324	4.9
Natural Gas Customers (Residential)	8,821	8,566	8,450	4.4	8,590	8,331	3.1
Natural Gas Customers (Industrial)	15	15	11	36.4	12	12	2.5
Southwestern (Beaver, Iron, Washington, Garfield, Kane Counties)							
Non-Ag. Employment (thous.)*	16.0	16.3	15.2	5.3	16.1	15.1	6.6
Auth. Permit Construction (mil. of dol.)	3.9	2.3	3.6	8.3	5.0	4.7	6.4
New Dwelling Units	50	64	78	−35.9	89	107	−17.1
Postal Receipts (thous.)†	178.8	92.1	84.2	112.4	106.0	72.3	46.6
Electric Customers (Residential)	10,322	10,266	9,895	4.3	10,077	9,511	5.9
Electric Customers (Commercial)	2,416	2,450	2,354	2.6	2,374	2,175	9.2

† Includes two 4-week periods.

Finally, various load management policies, i.e., policies designed to induce customers to shift their use of electricity to off peak hours, are being examined as to potential peak load reducing effects. One such policy is to shift to some form of peak load or time-of-day pricing structure. Other options include the encouragement of end use storage systems such as for space heating or water heating, and the implementation of either timed or utility controlled switches on heavy use appliances, such as water heaters. Such switches would turn these appliances off at designated peak hours.

While the exact nature and magnitudes of the relationship currently being analyzed are not yet fully understood, the effort being expended on them can be expected to prove fruitful over the next several years. As this comes about, electricity demand forecasting models will be able to generate more reliable projections. Perhaps more importantly, they will also become better able to simulate the impact of various economic and public policy changes. In this case, perhaps the most useful roles for such models in the future may be as providers of information crucial to the design of policies and procedures for dealing with energy problems in the last two decades of the twentieth century.

BUSINESS STATISTICS
Sources and Footnotes

Sources:

Agriculture farm marketings, livestock slaughter, farm prices: U.S. Department of Agriculture
Loans, Investments, deposits: Federal Reserve reports
Savings, Savings and Loan Association: Utah savings and loan institutions
U.S. Savings Bonds: U.S. Treasury Department
New Corporations: Utah Secretary of State
Tax Collections: Utah State Tax Commission
Employment data: Utah Department of Employment Security
Construction: Dodge Construction Statistics and BEBR
Air Passengers: Salt Lake International Airport, statistics service
Traffic Count: Utah Department of Transportation, Travel Analysis Unit
Visits to State and National Parks and Monuments: U.S. Forest Service; Utah State Parks and Recreation Department
Truck and car sales: Utah Automobile Dealers Registrations Service Company
Telephone, electric, natural gas customers: cooperating Utah utility companies
Net Electric Power Utilized: cooperating Utah power companies
Crude Oil to Refineries: cooperating Utah oil refineries
Copper production: U.S. Bureau of Mines
Coal production: U.S. Department of Energy
Oil and gas production: State of Utah Division of Oil, Gas and Mining

Footnotes:

* May not add to total due to rounding
[a] End of Period, includes member banks of Federal Reserve System
[b] As of the close of business on last day of the month
[c] Current year—preliminary data; previous year—final figures.
[d] Includes nonprofit and religious
[e] Includes public schools and colleges
[f] Total new construction plus additions, alterations and repairs
[g] Beginning January 1979, data reported in metric tons; to convert metric tons to short tons, multiply by 1.10231
[h] Includes Salt Lake County and Bountiful
[i] Includes Weber and Morgan Counties
[j] Includes Orem and Springville
r revised
x increase from zero or decrease to zero
na not available

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[redacted] SAI
CONGRESSIONAL
INFORMATION SERVICE, INC.
7101 WISCONSIN AVENUE
WASHINGTON, D.C. 20014

DAVID P. GARDNER, *President, University of Utah*
A. BLAINE HUNTSMAN, *Dean, College of Business*

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